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namely, Rear-Admiral D. W. Taylor, Chief Constructor; Rear-Admiral R. S. Griffin, Engineer-in-Chief; and Dr. J. D. Gatewood, Medical Director.

It was voted to appoint a committee consisting of V. C. Vaughan (chairman), C. B. Davenport, H. H. Donaldson, W. H. Holmes, and Raymond Pearl to consider the organization of research in anthropological and sociological sciences, and to report to the Executive Committee in regard to this matter.

A report was presented from the Chemistry Committee in regard to appointment of sub-committees. It was voted that such committees be appointed by the Research Council on nomination of the Chemistry Committee.

The sixth meeting of the Executive Committee was held on November 15, 1916, in Boston. Messrs. Conklin, Hale, Noyes, Pearl, Stratton, Vaughan, and Welch were present.

A report was presented from the Committee on Chemistry (M. T. Bogert, chairman) recommending the organization of a number of sub-committees. It was voted to defer action on these committees until the relation of certain of them to other branches of science could be properly considered.

The Committee then took up the consideration of the formation of general committees representing various branches of science. It was voted to organize the following general science committees (in addition to that on Chemistry previously established): Mathematics. Astronomy. Physics. Geology and Paleontology. Geography. Botany. Zoology and Animal Morphology. Physiology. Medicine. Hygiene. Agriculture. Psychology. Anthropology.

CARY T. HUTCHINSON, *Secretary.*

NATIONAL RESEARCH COUNCIL

SCIENTIFIC RESEARCH FOR NATIONAL DEFENSE AS ILLUSTRATED BY THE PROBLEMS OF AERONAUTICS

Abstract from an Address of Lieut. Colonel George O. Squier, U. S. A.

The following are some present problems connected with the development of Military Aviation and Aerostation.

1. *Aerodynamics.*—(*a*) Continue the development of the mathematical theory to explain the aerodynamic phenomena recorded in the aerodynamical laboratories, and to forecast further results.

(*b*) Obtain solutions for the speed and direction of flow of air about geometric and aerotechnic forms and develop experimental means to visualize or map the speed and direction of flow.

(*c*) Map the currents of the upper atmosphere which may be of most use in aerial navigation, and evolve simple practical rules for the guidance of pilots.

(*d*) Give fuller explanation of the phenomena of soaring, i.e., airplaning indefinitely without motive power.

(*e*) Develop equations and laws of comparison by which the behavior of large aircraft may be more accurately foretold from tests of models. Apply further the principle of dynamical similarity.

(*f*) Investigate more direct and effective methods of securing a lift or thrust in the air from the consumption of fuel.

(*g*) Complete theory of the air-screw.

2. *Engine problems requiring research.*—(*a*) Fuel. Possibly the most far-reaching problem is fuel. A fuel that will carry more power into an engine per unit volume will be a direct gain.

Attempts have been made to combine alcohol, gasoline, acetylene, picric acid, ether and other hydrocarbons with the above object in view. Questionable results have followed. There has been an increase of power, but nothing so far commercially or practically useful.

This question must be studied with the greatest of care and from a truly research standpoint.

(*b*) Solid fuel. Solid fuels that can be converted into liquid in small quantities just prior to use, are desirable for military aviation. In case of accident from shot or shock, leakage of liquid fuel is a danger. Solid fuel could be carried in quantity with less danger.

(*c*) Engine cooling. The problem of radiation is important. If some substance could be found that would circulate through the cooling system, at higher temperatures than water, it is probable that greater engine efficiencies would result. Oils, salt waters, and other materials have been tried with indifferent success.

(*d*) Liquid fuel pipes. Tubing that will resist vibration (causing rupture) is desired. An oil and gasoline proof rubber tubing is reported as used in Europe. This development is highly important, not only for tubing, but for containers in which to carry liquid fuel. Some sort of fabric and rubber tank that would really resist the action of gasoline, would be of the highest benefit.

A difficulty lies in the fact that the tanks are large (say 20 to 100 gallon capacity). The structural problems would be serious. The tanks now used are large and of metal. Vibration causes much difficulty and leakage.

(*e*) Metal coating. The protecting of the metal parts of an airplane, especially the fittings and cables, is a serious problem. A material is desired that would really prevent dangerous corrosion. Nickel plating over copper is very good, but will not suffice. Rust strikes through very rapidly. Baked enamel is the best coating. It is impossible to apply in many cases.

(*f*) Sound. The question of eliminating the noises involved in the operation of aircraft is one of importance. The peculiar note of the propeller of a Zeppelin can be heard for several miles, and is usually the first warning of its approach at night.

3. *Miscellaneous.*—(*a*) Physiological. Study the physiological and psychological effects of low density air at high altitudes on the performance of pilots.

(*b*) Transparent wing covering for airplanes. A wing covering which would answer the following general requirements would be of great value to military aviation:

Weight not more than 5 ounces per square yard.

It should present reasonably great resistance to flame.

It should be reasonably proof against action of salt water, moist air, extreme dryness, and quick temperature changes.

It should not stretch in any direction. Its ability to retain original form as placed on the airplane is very important.

It should have tensile strength of at least 75 pounds per inch width in any direction.

Its tendency to tear and split because of tack holes through it, or because of bullet holes, should be as small as possible.

(*c*) Development of light alloys for airplane construction. Pure aluminium or aluminium alloys. It is believed that a great deal can be done in this direction. So far no alloy has been developed, except possibly in Germany, which can compare with average Alaskan spruce in its 'specific tenacity.'

(*d*) The structure of gusts. It is believed that this is of sufficient importance to aviation to warrant considerable expense in its study.

Painstaking investigation of the character of eddy formations caused when wind strikes trees, hollows, cliffs, etc., and the character of disturbances created by canyons, swamps, deserts, etc., would be of great value to aviators.

This can be done not only by smoke and toy balloon work in the vicinity of obstructions such as the above, but also by photographic work in wind channels.

A set of simple rules laying down just what the aviator may expect on one side or another of canyons, cities, trees, lakes and swamps would be very helpful in aviation.

(*e*) Radio-apparatus for aircraft. The subject of radio-intercommunication between aircraft in flight, and between aircraft and the earth requires for its solution the highest possible efficiency and reliability combined with minimum weight.

A present tendency is to separate entirely the power plant from the main engine of an aircraft. The generator body in this case has a stream-line figure and a separate small air-screw is provided. Among other methods the oscillion is being tried as the actual source of continuous electromagnetic waves.

(*f*) Bullet proof gasoline tanks. Development of a material with which to line or construct tanks to contain the gasoline in an airplane in which a bullet hole will quickly close, entirely or partly at least. This would enable many a flier to get back to his own lines after having been fired upon.

(*g*) Development of a fabric as good as, or better than, Irish linen, for the covering of airplanes. There has not been manufactured in this country a fabric suitable for use in covering airplanes.

The fabric should answer all requirements laid down under *transparent wing covering*, and be, in addition, such as to shrink the proper amount without harm when cellulose solution is applied.

It is possible that long fiber cotton might be developed that would answer the purpose.

We must become independent in all lines affecting our military aviation. Today we depend entirely upon Ireland and England for our linen, and the supply is becoming very low in this country.

(*h*) Aviator's clothing. Much is still to be done in devising non-inflammable and protective clothing for aviators. This question is intimately connected with personal armor and safety in case of fall.

(*i*) Ground-speed indicator. An instrument which would measure the actual speed of an aircraft over the ground would be useful in the operation of military machines.

4. *Physics of the Air.*—A number of physical properties of air, important in the problems of avaiation, were also discussed.

RESEARCH GRANTS FROM THE TRUST FUNDS OF THE ACADEMY

Since the last report, these PROCEEDINGS **2**, 307, the following grants for the promotion of research have been made from the Trust Funds of the Academy.

GRANTS FROM THE BACHE FUND

No. 196, H. N. NORRIS, $100. For assistance in making numerous preliminary sketches and drawings, involved in the plotting from serial sections, the immediate work to be carried on with Cryptobranchus material. An investigation of the cranial nerves of the Amphibia, involving first, an analysis of the nerve components of representative and typical Modela, on the plan followed in the writer's papers on the cranial nerves of Amphinnea and Siren; second, a review of the nerve component in the Anura. Finally a monograph on the cranial nerves of the Amphibia as a whole.

No. 197, G. P. BAXTER, Harvard University, $300. For the purchase of platinum and quartz apparatus, instruments of precision, special glass apparatus and glass blowing, and special chemicals for the determination of atomic weights; namely, of arsenic and iodine, by iodimetric comparison of arsenic trioxide with iodine and iodine pentoxide, and of various metals by electrolysis of weighed amounts of salts, and by coulometric comparison.

No. 198, L. T. MORE, University of Cincinnati, $500. For the purchase of a high voltage (200,000 volts), large current (10 kilowatt) generator of the transformer synchronous commutator type, to examine the region of the radiation spectrum between the hardest known X-rays and the X-rays of radium and the characteristic K radiation and its absorption by various metals.

No. 199, F. P. REAGAN, $100. For an intensive study of haematopolsis in teleost embryos involving continual observation.

No. 200, H. W. NORRIS, Grinnell College, $250. For an investigation of the cranial nerve components of the common dogfish, squales, acanthias; an analysis of the cranial ganglia and the peripheral distribution of the component fibers.

No. 201, A. F. SHULL, $400. To discover the causes of the changes in the life cycles of rotifers, aphids, and thrips, with special reference to the determination of sex; also related cyclical phenomena in the aphids, primarily the sporadic production of wings.